

## REMARKS

In view of the following remarks, reconsideration of the rejections contained in the Office Action of August 31, 2009 is respectfully requested.

On pages 3-6 of the Office Action, the Examiner rejected claims 1, 4 and 9 under 35 U.S.C. § 103(a) as being unpatentable over Herrington et al. (US 4,618,713) in view of Tung et al. (US 2003/0027912). On pages 6-10 of the Office Action, the Examiner rejected claims 5, 8 and 10 under 35 U.S.C. § 103(a) as being unpatentable over Herrington in view of Tung, and further in view of Wachs (US 6,497,855) and Borsboom et al. (US 4,981,661). For the reasons discussed below, it is respectfully submitted that the present claims are clearly patentable over the prior art of record.

Independent claim 1 recites a COS treatment apparatus for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO. The COS treatment apparatus of claim 1 includes a first reactor into which the gasified gas is to be introduced, the first reactor being configured to increase an initial concentration of COS in the gas and decrease concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas at a gas temperature of at least 300°C. The COS treatment apparatus of claim 1 also includes a second reactor located at a downstream side of a gasified gas flow with respect to the first reactor, the second reactor being configured to decrease the increased concentration of COS in the gas passed through the first reactor to a concentration lower than the initial concentration of COS in the gas.

Claim 1 also recites that *the first reactor comprises an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$ , with the O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO.* Further, claim 1 recites that the second reactor comprises a COS conversion catalyst.

Herrington discloses a three-step cycle for converting carbon monoxide and carbon dioxide into valuable organic compounds, as shown in Cycles A-C (column 2, line 55 through column 3, line 25) and Fig. 1, with the main difference between each cycle being the valuable organic compound obtained at the end (e.g., CH<sub>3</sub>OH, CH<sub>4</sub> or C<sub>3</sub>H<sub>6</sub>). As shown in Fig. 1, Herrington discloses that (1) H<sub>2</sub>S and CO are introduced into the first reactor to form COS and H<sub>2</sub>, (2) the COS from the first reactor is introduced into the second reactor along with O<sub>2</sub> to form CO and SO<sub>2</sub>, and (3) the CO from the second reactor and the H<sub>2</sub> from the first reactor are introduced into a third reactor to form CH<sub>3</sub>OH (or CH<sub>4</sub> and H<sub>2</sub>O).

However, Herrington does not disclose a first reactor into which a gasified gas containing

COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO is to be introduced, with *the first reactor comprising an O<sub>2</sub> removal catalyst for accelerating the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O*, as required by independent claim 1. Rather, as indicated above, Herrington only discloses that H<sub>2</sub>S and CO are introduced into the first reactor, and does not disclose or suggest that O<sub>2</sub> is introduced into the first reactor. Further, it is noted that the first reactor of Herrington produces H<sub>2</sub> which is required for the valuable organic compound to be obtained in the third step of the cycle. In this regard, it is noted that introducing O<sub>2</sub> into the first reactor of Herrington would prevent the first reactor from producing the H<sub>2</sub> which is required to subsequently produce the valuable organic compound in the third reactor, and therefore one of ordinary skill in the art would not have modified the apparatus of Herrington by introducing O<sub>2</sub> into the first reactor.

Further, as Herrington does not disclose that O<sub>2</sub> is introduced into the first reactor, Herrington does not disclose that the first reactor comprises an O<sub>2</sub> removal catalyst, as required by independent claim 1. In addition, as Herrington only discloses that H<sub>2</sub>S and CO are introduced into the first reactor to form COS and H<sub>2</sub>, Herrington does not disclose that the first reactor comprises an O<sub>2</sub> removal catalyst for accelerating the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O, as also required by independent claim 1.

Additionally, as acknowledged by the Examiner on page 4 of the Office Action, Herrington does not disclose *an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO*, as required by independent claim 1. In this regard, the Examiner cites Tung as disclosing TiO<sub>2</sub>, Cr<sub>2</sub>O<sub>3</sub> and NiO as oxygen-scavenging elements, and concludes that it would have been obvious to choose an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO to enhance a reaction with molecular oxygen.

However, it is first noted that modifying the first reactor of Herrington to include an O<sub>2</sub> removal catalyst would not “enhance a reaction with molecular oxygen” as asserted by the Examiner, because Herrington does not disclose that O<sub>2</sub> is introduced into the first reactor, and modifying Herrington by introducing O<sub>2</sub> into the first reactor would prevent the first reactor from producing the H<sub>2</sub> which is required to subsequently produce the valuable organic compound in the third reactor.

Further, it is noted that Tung discloses an oxygen-scavenging resin, which is fundamentally different from a catalyst. In particular, it is noted that a catalyst alters the rate of a chemical reaction but is chemically unchanged at the end of the reaction. However, an oxygen-

scavenging particle is an oxidizable material capable of reacting with oxygen (and is therefore chemically changed at the end of the reaction), as disclosed by Tung. Accordingly, it is respectfully submitted that the oxygen-scavenging resin of Tung is not an O<sub>2</sub> removal catalyst, as required by independent claim 1, and therefore one of ordinary skill in the art would not have modified the process of Herrington to include an oxygen-scavenging resin as taught by Tung.

Thus, as Herrington does not disclose that O<sub>2</sub> is introduced into the first reactor and does not disclose that the first reactor comprises an O<sub>2</sub> removal catalyst, and because the oxygen-scavenging resin of Tung is not an O<sub>2</sub> removal catalyst, it is respectfully submitted that one of ordinary skill in the art would not have modified the first reactor of Herrington to include the oxygen-scavenging resin of Tung so as to result in a first reactor comprising an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 1.

Independent claim 9 recites a COS treatment apparatus for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO. The treatment apparatus of claim 9 includes a reactor into which the gasified gas is to be introduced, with *the reactor being configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>*, and with the reactor comprising *a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO*. Claim 9 also recites that *the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO is an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$* , and that the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO is a COS conversion catalyst.

Herrington does not disclose a reactor into which a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO is to be introduced, with *the reactor being configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>*, and with the reactor comprising *a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO*, with *the TiO<sub>2</sub> catalyst being an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$* , as required by independent claim 9.

Rather, as indicated above, Herrington only discloses that H<sub>2</sub>S and CO are introduced into the first reactor to form COS and H<sub>2</sub>, and COS from the first reactor is introduced into the second reactor along with O<sub>2</sub> to form CO and SO<sub>2</sub>. However, none of the first and second reactors of Herrington are configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and none of the first and second reactors of Herrington are disclosed as comprising an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 9.

Thus, as none of the first and second reactors of Herrington are configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and as none of the first and second reactors of Herrington are disclosed as comprising an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , Herrington does not disclose a reactor which is both configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and comprises an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 9.

Additionally, as acknowledged by the Examiner on page 5 of the Office Action, Herrington does not disclose *a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO, with the TiO<sub>2</sub> catalyst being an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$* , as required by independent claim 9. In this regard, the Examiner cites Tung as disclosing TiO<sub>2</sub>, Cr<sub>2</sub>O<sub>3</sub> and BaO as oxygen-scavenging elements, and concludes that it would have been obvious to choose an O<sub>2</sub> removal catalyst comprising TiO<sub>2</sub> carrying Cr<sub>2</sub>O<sub>3</sub> and BaO.

However, it is noted that Tung discloses an oxygen-scavenging resin, which is fundamentally different from a catalyst. In particular, it is noted that a catalyst alters the rate of a chemical reaction but is chemically unchanged at the end of the reaction. However, an oxygen-scavenging particle is an oxidizable material capable of reacting with oxygen (and is therefore chemically changed at the end of the reaction), as disclosed by Tung. Accordingly, it is respectfully submitted that the oxygen-scavenging resin of Tung is not an O<sub>2</sub> removal catalyst, as required by independent claim 9, and therefore one of ordinary skill in the art would not have modified the process of Herrington to include an oxygen-scavenging resin as taught by Tung.

Further, it is noted that like Herrington, Tung does not disclose or suggest a reactor which is both configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and comprises an O<sub>2</sub> removal catalyst for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 9. Accordingly, as none of the Herrington and Tung references discloses or suggests a reactor configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and which comprises an O<sub>2</sub> removal catalyst (comprising TiO<sub>2</sub> carrying Cr<sub>2</sub>O<sub>3</sub> and BaO) for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 9, it is respectfully submitted that the combination of the Herrington and Tung references does not disclose or suggest a reactor configured to convert COS to H<sub>2</sub>S in the presence of O<sub>2</sub>, and which comprises an O<sub>2</sub> removal catalyst (comprising TiO<sub>2</sub> carrying Cr<sub>2</sub>O<sub>3</sub> and BaO) for accelerating the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ .

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in independent claims 1 and 9 is not disclosed or suggested by the Herrington reference and the Tung reference taken either individually or in combination. Accordingly, a person having ordinary skill in the art would clearly not have modified the Herrington reference in view of the Tung reference in such a manner as to result in or otherwise render obvious the present invention of independent claims 1 and 9.

Independent claim 5 recites a COS treatment method for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO. The method of claim 5 includes *increasing an initial concentration of COS in the gas and decreasing concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas by using an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO at a gas temperature of at least 300°C to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$* . The method of claim 5 also includes, after the increasing of the initial concentration of COS in the gas and the decreasing of the concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas, decreasing the increased concentration of COS in the gas to a concentration lower than the initial concentration of COS in the gas by converting COS contained in the gas to H<sub>2</sub>S by using a COS conversion catalyst.

Herrington discloses a three-step cycle for converting carbon monoxide and carbon dioxide into valuable organic compounds, as shown in Cycles A-C (column 2, line 55 through column 3, line 25) and Fig. 1, with the main difference between each cycle being the valuable organic compound obtained at the end (*e.g.*, CH<sub>3</sub>OH, CH<sub>4</sub> or C<sub>3</sub>H<sub>6</sub>). As shown in Fig. 1, Herrington discloses that (1) H<sub>2</sub>S and CO are introduced into the first reactor to form COS and H<sub>2</sub>, (2) the COS from the first reactor is introduced into the second reactor along with O<sub>2</sub> to form CO and SO<sub>2</sub>, and (3) the CO from the second reactor and the H<sub>2</sub> from the first reactor are introduced into a third reactor to form CH<sub>3</sub>OH (or CH<sub>4</sub> and H<sub>2</sub>O).

However, Herrington does not disclose a treatment method for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO which includes *increasing an initial concentration of COS in the gas and decreasing concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas by using an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO at a gas temperature of at least 300°C to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$* , as required by independent claim 5. Rather, as indicated above, Herrington only discloses that H<sub>2</sub>S and CO are introduced into the first reactor to form COS and H<sub>2</sub>, and COS from the first reactor is introduced

into the second reactor along with O<sub>2</sub> to form CO and SO<sub>2</sub>, and does not disclose or suggest decreasing concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas by using an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO at a gas temperature of at least 300°C to accelerate the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 5.

In addition, Herrington does not disclose *increasing an initial concentration of COS in the gas and decreasing concentrations of H<sub>2</sub>S, CO and O<sub>2</sub> in the gas, and thereafter, decreasing the increased concentration of COS in the gas to a concentration lower than the initial concentration of COS*, as required by independent claim 5. Rather, as indicated above, Herrington only discloses that COS is produced in the first reactor from H<sub>2</sub>S and CO, and that the COS from the first reactor is used in the second reactor along with O<sub>2</sub> to form CO and SO<sub>2</sub>. In other words, Herrington only discloses that an amount of COS is increased (from zero) in the first reactor and decreased (to zero) in the second reactor, but does not disclose or suggest decreasing the increased concentration of COS in the gas to a concentration lower than the initial concentration of COS, as required by independent claim 5.

Additionally, as acknowledged by the Examiner on page 6 of the Office Action, Herrington does not disclose *an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO*, as required by independent claim 5. In this regard, the Examiner cites Tung as disclosing TiO<sub>2</sub>, Cr<sub>2</sub>O<sub>3</sub> and NiO as oxygen-scavenging elements, and concludes that it would have been obvious to choose an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> or consisting of TiO<sub>2</sub> and NiO to enhance a reaction with molecular oxygen.

However, it is noted that Tung discloses an oxygen-scavenging resin, which is fundamentally different from a catalyst. In particular, it is noted that a catalyst alters the rate of a chemical reaction but is chemically unchanged at the end of the reaction. However, an oxygen-scavenging particle is an oxidizable material capable of reacting with oxygen (and is therefore chemically changed at the end of the reaction), as disclosed by Tung. Accordingly, it is respectfully submitted that the oxygen-scavenging resin of Tung is not an O<sub>2</sub> removal catalyst, as required by independent claim 5, and therefore one of ordinary skill in the art would not have modified the process of Herrington to include an oxygen-scavenging resin as taught by Tung.

Further, like Herrington, Tung does not disclose using an O<sub>2</sub> removal catalyst to accelerate the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ . Accordingly, as none of the

Herrington and Tung references discloses using an O<sub>2</sub> removal catalyst to accelerate the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , it is respectfully submitted that the combination of the Herrington and Tung references does not disclose or suggest using an O<sub>2</sub> removal catalyst to accelerate the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , as required by independent claim 5.

Additionally, as acknowledged by the Examiner on pages 6-7 of the Office Action, Herrington does not disclose a treatment method *for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO*, as required by claim 5. In this regard, the Examiner cites Wachs as disclosing that COS is found in many industrial processes, and cites Borsboom as disclosing that gas from a coal gasification process commonly contains H<sub>2</sub>S, CO and sometimes also O<sub>2</sub>. Thus, the Examiner concludes that it would have been obvious to use a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO in the method of Herrington.

However, as indicated above, Herrington only discloses that H<sub>2</sub>S and CO are introduced into the first reactor to produce H<sub>2</sub> which is required for the valuable organic compound to be obtained in the third step of the cycle. However, Herrington does not disclose or suggest that introducing COS, H<sub>2</sub>O and O<sub>2</sub> along with H<sub>2</sub>S and CO into the first reactor would still allow the H<sub>2</sub>S and CO to react so as to produce the H<sub>2</sub> which is required for the valuable organic compound to be obtained in the third step of the cycle. Accordingly, as Herrington only discloses that the first reactor produces H<sub>2</sub> by the reaction of only CO and H<sub>2</sub>S, one of ordinary skill in the art would not have had a reasonable chance of success of producing the required H<sub>2</sub> in the first reactor by introducing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO into the first reactor of Herrington.

Therefore, in view of the above, it would not have been obvious to one of ordinary skill in the art to combine the method of Herrington with the introduction of COS, H<sub>2</sub>O and O<sub>2</sub> (as disclosed by Wachs and Borsboom) along with H<sub>2</sub>S and CO into the first reactor, and to include the oxygen-scavenging resin of Tung so as to result in or render obvious the invention of independent claim 5, because none of Herrington, Tung, Wachs and Borsboom disclose or suggest a method which includes increasing an initial concentration of COS in the gas by using an O<sub>2</sub> removal catalyst consisting of TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> (or consisting of TiO<sub>2</sub> and NiO) to accelerate the following reaction:  $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ , and thereafter decreasing the increased concentration of COS in the gas to a concentration lower than the initial concentration of COS as required by independent claim 5.

Independent claim 10 recites a COS treatment method for a gasified gas containing COS,  $H_2S$ ,  $H_2O$ ,  $O_2$ , and CO. The method of claim 10 includes removing  $O_2$  from the gas by *using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$* . The method of claim 10 also includes *simultaneously converting COS to  $H_2S$  by using the  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO*.

Herrington does not disclose removing  $O_2$  from a gasified gas containing COS,  $H_2S$ ,  $H_2O$ ,  $O_2$ , and CO by *using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$ , and simultaneously converting COS to  $H_2S$  by using the  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO*, as required by independent claim 10.

Rather, as indicated above, Herrington only discloses that COS is converted to CO and  $SO_2$  in the second reactor, and does not disclose converting COS to  $H_2S$  by using the  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO, as required by independent claim 10. Further, Herrington does not disclose or suggest using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$ . Accordingly, as Herrington does not disclose using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$ , and also does not disclose converting COS to  $H_2S$  by using the  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO, Herrington thus does not disclose or suggest using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$  and simultaneously converting COS to  $H_2S$  by using the  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO, as required by independent claim 10.

Additionally, as acknowledged by the Examiner on page 8 of the Office Action, Herrington does not disclose *using a  $TiO_2$  catalyst carrying  $Cr_2O_3$  and BaO to accelerate the following reaction:  $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$* , as required by independent claim 10. In this regard, the Examiner cites Tung as disclosing  $TiO_2$ ,  $Cr_2O_3$  and BaO as oxygen-scavenging elements, and concludes that it would have been obvious to choose an  $O_2$  removal catalyst comprising  $TiO_2$  carrying  $Cr_2O_3$  and BaO.

However, as discussed above, Tung discloses an oxygen-scavenging resin, which is fundamentally different from a catalyst in that a catalyst alters the rate of a chemical reaction but is chemically unchanged at the end of the reaction, while an oxygen-scavenging particle is an oxidizable material capable of reacting with oxygen (and is therefore chemically changed at the end of the reaction), as disclosed by Tung. Accordingly, it is respectfully submitted that the



oxygen-scavenging resin of Tung is not an O<sub>2</sub> removal catalyst, as required by independent claim 10, and therefore one of ordinary skill in the art would not have modified the process of Herrington to include an oxygen-scavenging resin as taught by Tung.

Further, it is noted that like Herrington, Tung does not disclose or suggest using a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O, and simultaneously converting COS to H<sub>2</sub>S by using the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO, as required by independent claim 10. Accordingly, as none of the Herrington and Tung references discloses or suggests using a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O, and simultaneously converting COS to H<sub>2</sub>S by using the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO, as required by independent claim 10, it is respectfully submitted that the combination of the Herrington and Tung references does not disclose or suggest using a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O, and simultaneously converting COS to H<sub>2</sub>S by using the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO.

Additionally, as acknowledged by the Examiner on page 9 of the Office Action, Herrington does not disclose a treatment method *for a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO*, as required by claim 10. In this regard, the Examiner cites Wachs as disclosing that COS is found in many industrial processes, and cites Borsboom as disclosing that gas from a coal gasification process commonly contains H<sub>2</sub>S, CO and sometimes also O<sub>2</sub>. Thus, the Examiner concludes that it would have been obvious to use a gasified gas containing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO in the method of Herrington.

However, as indicated above, Herrington discloses that only H<sub>2</sub>S and CO are introduced into the first reactor to produce COS, and to produce H<sub>2</sub> which is required for the valuable organic compound to be obtained in the third step of the cycle, and that the COS from the first reactor is converted to CO and SO<sub>2</sub> in the second reactor. However, none of Herrington, Wachs or Borsboom discloses or suggests that introducing COS, H<sub>2</sub>O and O<sub>2</sub> along with H<sub>2</sub>S and CO into the first reactor of Herrington would still allow the H<sub>2</sub>S and CO to react so as to produce the H<sub>2</sub> which is required for the valuable organic compound to be obtained in the third step of the cycle. Accordingly, as Herrington only discloses that the first reactor produces H<sub>2</sub> by the reaction of only CO and H<sub>2</sub>S, one of ordinary skill in the art would not have had a reasonable chance of success of producing the required H<sub>2</sub> in the first reactor by introducing COS, H<sub>2</sub>S, H<sub>2</sub>O, O<sub>2</sub>, and CO into the

first reactor of Herrington.

Further, none of Herrington, Wachs or Borsboom discloses or suggests that introducing COS, H<sub>2</sub>O and O<sub>2</sub> along with H<sub>2</sub>S and CO into the first reactor of Herrington would result in the use of a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O and simultaneously converting COS to H<sub>2</sub>S by using the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO, as required by independent claim 10, because Herrington only discloses converting COS to CO and SO<sub>2</sub>, and does not disclose or suggest using a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O.

Therefore, in view of the above, it would not have been obvious to one of ordinary skill in the art to combine the method of Herrington with the introduction of COS, H<sub>2</sub>O and O<sub>2</sub> (as disclosed by Wachs and Borsboom) along with H<sub>2</sub>S and CO into the first reactor, and to include the oxygen-scavenging resin of Tung so as to result in or render obvious the invention of independent claim 10, because none of Herrington, Tung, Wachs and Borsboom disclose or suggest a method which includes using a TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO to accelerate the following reaction: 2H<sub>2</sub>S + 2CO + O<sub>2</sub> → 2COS + 2H<sub>2</sub>O, and simultaneously converting COS to H<sub>2</sub>S by using the TiO<sub>2</sub> catalyst carrying Cr<sub>2</sub>O<sub>3</sub> and BaO, as required by independent claim 10.

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in independent claims 5 and 10 is not disclosed or suggested by the Herrington reference, the Tung reference, the Wachs reference and the Borsboom reference taken either individually or in combination. Accordingly, a person having ordinary skill in the art would clearly not have modified the Herrington reference in view of the Tung reference, the Wachs reference and the Borsboom reference in such a manner as to result in or otherwise render obvious the present invention of independent claims 5 and 10.

Therefore, it is respectfully submitted that independent claims 1, 5, 9 and 10, as well as claims 4 and 8 which depend therefrom, are clearly allowable over the prior art of record.

In view of the foregoing remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice to that effect is respectfully solicited.

If, after reviewing this response, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

Masahiro HARADA et al.

/Walter C. Pledger/

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February 1, 2010